CLAIMS

1. A method for forming a layer on at least a portion of a surface of a biocompatible medical device, the method comprising:

reacting a first functional group on a polysaccharide in a polysaccharide complex with a second functional group on the at least a portion of the surface of the medical device to covalently bond the polysaccharide to the surface in the presence of an organic solvent, wherein the polysaccharide complex comprises quaternary ammonium cations associated with the polysaccharide.

2. The method of claim 1 wherein the polysaccharide is a derivitized, natural polysaccharide.

3. The method of claim 1 wherein the polysaccharide, before being complexed with the quaternary cations, comprises the first functional group.

4. The method of claim 3 wherein the polysaccharide, before being complexed with the quaternary cations, is decorated with the first functional group in a chemical reaction that takes place in a non-organic solvent.

5. The method of claim 1 wherein the polysaccharide, after being complexed with the quaternary cations, is chemically decorated with the first functional group.

6. The method of claim 1 wherein the polysaccharide is a W-MPSAC.

7. The method of claim 1 wherein the polysaccharide is an O-MPSAC.

8. The method of claim 1 wherein the first functional group is a photoactivatable group.

9. The method of claim 1 wherein the second functional group is a photoactivatable group.

10. The method of claim 1 wherein the first functional group or the second functional group is an azide.

11. The method of claim 1 wherein the first functional group and the second functional groups are reactive functional groups that can undergo a reaction to bond to each other.

12. The method of claim 7 wherein the polymerizable groups are photoinitiatable free radical polymerization groups.

13. The method of claim 1 wherein the first functional group is an electrophile and the second functional group is a nucleophile.

14. The method of claim 1 wherein the first functional group or the second functional group comprises a member of the group consisting of primary amines, sulfhydryls, carboxyls, and hydroxyls.

15. The method of claim 1 wherein the first functional group or the second functional group comprises a member of the group consisting of methacrylates, acrylates, isocyanates, epoxides, carbodiimides, diimidazoles, and acid anhydrides.

16. The method of claim 1 wherein the organic solvent has a boiling point at atmospheric pressure of less than approximately 115 degrees Centigrade.

17. The method of claim 1 wherein the organic solvent has a boiling point at atmospheric pressure of less than approximately 70 degrees Centigrade.

18. The method of claim 16 wherein the organic solvent has a dielectric constant that is less than that of DMSO.

19. The method of claim 1 wherein the organic solvent has a dielectric constant that is less than that of DMSO.

20. The method of claim 1 further comprising removing the organic solvent by a process that uses a vacuum.

21. The method of claim 1 wherein polysaccharide is chosen from the group consisting of glycosaminoglycans, chondroitin sulfate, dermatan sulfate, heparan sulfate, keratan sulfate, proteoglycans and combinations thereof and mixtures thereof.

22. The method of claim 1 wherein polysaccharide comprises heparin.

23. The method of claim 1 further comprising reacting the first functional group with the second functional group in the presence of a member of a set consisting of monomers, polymers, and combinations thereof.

24. The method of claim 23 wherein the polymers comprise polyethylene glycol or a derivative of polyethylene glycol.

25. The method of claim 1 further comprising reacting the first functional group with the second functional group in the presence of polymer having a molecular weight of at least about 100,000.

26. The method of claim 1 further comprising reacting the first functional group with the second functional group in the presence of a third functional group, wherein the third functional group forms a covalent bond with at least one of the first functional group and the second functional group.

27. The method of claim 26 wherein the third functional group comprises a polymerizable or photoactivatable group.

28. The method of claim 26 wherein the third functional group comprises an acrylate or a methacrylate.

29. The method of claim 26 wherein the polysaccharide comprises the third functional group.

30. The method of claim 26 wherein, before the reaction of the third functional group, a monomer or polymer distinct from the polysaccharide and the surface comprises the third functional group.

31. The method of claim 1 further comprising exposing the covalently bonded polysaccharide complex to a salt solution to decomplex the quaternary ammonium cations from the polysaccharide bound to the surface.

32. The method of claim 1 wherein the quaternary ammonium cation is chosen from the group consisting of cetyltrimethylammonium chloride, dodecyldimethylbenzylammonium chloride, benzalkonium chloride, didecyldimethylammonium chloride, benzethonium chloride, hexyl trimethyl ammonium, decyl trimethyl ammonium, lauryl trimethyl ammonium, myristyl trimethyl ammonium, cetyl trimethyl ammonium, stearyl trimethyl ammonium, didecyl dimethyl ammonium, dilauryl dimethyl ammonium, and distearyl dimethyl ammonium.

33. The method of claim 1 wherein the organic solvent comprises at least one member of the group consisting of dimethylformamide, dimethylacetamide, dimethyl sulfoxide, hexamethylphosphoric triamide, formic acid, acetonitrile, methanol, ethanol, acetone, acetic acid, dichloromethane, pyridine, and formamide.

34. A method for forming a layer on at least a portion of a surface of a biocompatible medical device, the method comprising:

contacting the surface of the medical device with a plurality of synthetic polysaccharide polymers, with the polysaccharide polymers having an average length of at least two polysaccharides covalently bonded per polymer, to form the layer, wherein the polysaccharide polymers are formed by chemically reacting polysaccharide complexes in an organic solvent, the polysaccharide complexes comprising quaternary ammonium cations associated with polysaccharides and at least one functional group capable of forming a covalent bond.

35. The method of claim 34 wherein the polysaccharide is a derivitized, natural polysaccharide.

36. The method of claim 34 wherein the polysaccharide, before being complexed with the quaternary cations, comprises the functional group.

37. The method of claim 34 wherein the polysaccharide, before being complexed with the quaternary cations, is decorated with the functional group in a chemical reaction that takes place in a non-organic solvent.

38. The method of claim 34 wherein the polysaccharide is a W-MPSAC

39. The method of claim 34 wherein the polysaccharide is an O-MPSAC.

40. The method of claim 34 wherein the functional group is a photoactivatable group.

41. The method of claim 34 wherein the polysaccharide polymers further comprise a second functional group for forming a covalent bond after the layer is formed.

42. The method of claim 41 wherein the second functional group is a photoactivatable group.

43. The method of claim 42 wherein the second functional group is an azide.

44. The method of claim 34 wherein the functional group comprises a polymerizable group.

45. The method of claim 44 wherein the polymerizable groups comprises a photoinitiatable free radical polymerization group.

46. The method of claim 34 wherein the second functional group is a nucleophile.

47. The method of claim 34 wherein the functional group comprises a member of the group consisting of primary amines, sulfhydryls, carboxyls, and hydroxyls.

48. The method of claim 34 wherein the functional group comprises a member of the group consisting of methacrylates, acrylates, isocyanates, epoxides, carbodiimides, diimidazoles, and acid anhydrides.

49. The method of claim 34 wherein the organic solvent has a boiling point at atmospheric pressure of less than approximately 115 degrees Centigrade.

50. The method of claim 34 wherein the organic solvent has a boiling point at atmospheric pressure of less than approximately 70 degrees Centigrade.

51. The method of claim 50 wherein the organic solvent has a dielectric constant that is less than that of DMSO.

52. The method of claim 34 wherein the organic solvent has a dielectric constant that is less than that of DMSO.

53. The method of claim 34 further comprising removing the organic solvent by a process that uses a vacuum.

54. The method of claim 34 wherein polysaccharide is chosen from the group consisting of macromers of glycosaminoglycans, chondroitin sulfate, dermatan sulfate, heparan sulfate, keratan sulfate, and proteoglycans.

55. The method of claim 34 wherein polysaccharide comprises heparin.

56. The method of claim 34 further comprising polymerizing monomers into the polysaccharide polymers.

57. The method of claim 34 wherein the polysaccharide polymers are formed in the presence of a solubilized a non-polysaccharide polymer.

58. The method of claim 57 wherein the non-polysaccharide polymer comprises polyethylene glycol or a derivative of polyethylene glycol.

59. The method of claim 34 wherein the polysaccharide polymers further comprise non-polysaccharide polymers.

60. The method of claim 59 wherein the non-polysaccharide polymers comprise an acrylate or a methacrylate that participates in the formation of a covalent bond between the non-polysaccharide polymers and the polysaccharide-polymers.

61. The method of claim 34 wherein the polysaccharide polymer comprises a cross-linked structure.

62. The method of claim 34 wherein the polysaccharide polymer comprises a branched structure.

63. The method of claim 34 wherein the polysaccharide polymer has an average molecular weight in the range of about 50,000 and about 5,000,000.

64. The method of claim 34 wherein the polysaccharide polymer is covalently bonded to the surface.

65. The method of claim 34 wherein the polysaccharide polymer is bound to the surface through electrostatic interactions.

66. The method of claim 34 wherein the polysaccharide complex is covalently bonded to the surface and further comprising exposing the covalently bonded polysaccharide complex to a salt solution to decomplex the quarterary ammonium cations from the polysaccharide bound to the surface.

67. The method of claim 34 wherein the quaternary ammonium cation is chosen from the group consisting of cetyltrimethylammonium chloride, dodecyldimethylbenzylammonium chloride, benzalkonium chloride, didecyldimethylammonium chloride, benzethonium chloride,

hexyl trimethyl ammonium, decyl trimethyl ammonium, lauryl trimethyl ammonium, myristyl trimethyl ammonium, cetyl trimethyl ammonium, stearyl trimethyl ammonium, didecyl dimethyl ammonium, dilauryl dimethyl ammonium, and distearyl dimethyl ammonium.

68. The method of claim 34 wherein the organic solvent comprises at least one member of the group consisting of dimethylformamide, dimethylacetamide, dimethyl sulfoxide, hexamethylphosphoric triamide, formic acid, acetonitrile, methanol, ethanol, acetone, acetic acid, dichloromethane, pyridine, and formamide.

69. A preparation of a synthetic modified polysaccharide polymer soluble in a solvent comprising:

at least two polysaccharides joined with at least one covalent bond to the modified polymer, wherein the modified polysaccharide polymer has a branched structure and has a molecular weight of at least 50,000.

70. The preparation of claim 69 wherein the polysaccharides are polymerized to the polymer by the reaction of chemical moieties chosen from the group from the group consisting of polyhydroxyethylmethylacrylates, methyl methacrylates, methacrylates, acrylates, photopolymerizable monomers, monomers with hydroxyl groups, monomers with glycerol groups, monomers with polyoxyalkylene ether groups, monomers with polypropylene oxide groups, monomers with vinyl groups, monomers with zwitterionic groups, monomers with silicone groups, monomers having sulphate groups, monomers having sulphonate groups, and heparin monomer, and wherein the polymer is in an isolatable form.

71. The preparation of claim 69 wherein the polysaccharides comprise heparin.

72. The preparation of claim 69 wherein the polysaccharides are chosen from the group consisting of glycosaminoglycans, chondroitin sulfate, dermatan sulfate, heparan sulfate, keratan sulfate, and proteoglycans.

73. The preparation of claim 69 wherein the polysaccharides are polymerized in a solvent chosen from the group consisting of aqueous solvents, organic solvents, and mixtures thereof.

74. The preparation of claim 69 wherein the polysaccharides are complexed with cations.

75. The preparation of claim 69 further comprising an organic solvent, and wherein the modified polysaccharide polymer is soluble in the organic solvent.

76. The preparation of claim 69 wherein the modified polysaccharide polymer further comprises a chemical group for forming a covalent bond with a functional group.

77. The preparation of claim 76 wherein the chemical group is a photoactivatable functional group.

78. The preparation of claim 77 wherein the photoactivatable functional group is an azide.

79. The preparation of claim 77 wherein the polysaccharide polymer comprises polysaccharides covalently bonded to each other to form the polysaccharide polymer.

80. The preparation of claim 77 wherein the polysaccharide polymer comprises polysaccharide and non-polysaccharide polymers.

81. A medical device surface having a layer on at least a portion if its surface, the layer comprising:

polysaccharide polymers comprising at least two polysaccharides synthetically covalently bonded per polymer wherein the polysaccharide polymers are covalently linked to the surface with at least one covalent bond per polysaccharide polymer.

82. The medical device of claim 80 wherein the polysaccharide is a derivitized, natural polysaccharide.

83. The medical device of claim 80 wherein the polysaccharide is an O-MPSAC.

84. The medical device of claim 80 wherein the covalent bond is formed from a photoactivatable group.

85. The medical device of claim 83 wherein the photoactivatable group is an azide.

86. The medical device of claim 80 wherein the covalent bond is formed from a polymerizable group.

87. The medical device of claim 80 wherein the covalent bond is formed from a member of the group consisting of methacrylates, acrylates, isocyanates, epoxides, carbodiimides, diimidazoles, and acid anhydrides.

88. The medical device of claim 80 wherein polysaccharide is chosen from the group consisting of macromers of glycosaminoglycans, chondroitin sulfate, dermatan sulfate, heparan sulfate, keratan sulfate, and proteoglycans.

89. The medical device of claim 80 wherein polysaccharide comprises heparin.

90. The medical device of claim 88 wherein the polysaccharide polymers further comprise non-polysaccharide polymers.

91. The medical device of claim 88 wherein the polysaccharide polymer comprises a cross-linked structure.

92. The medical device of claim 88 wherein the polysaccharide polymer comprises a branched structure.

93. The medical device of claim 88 wherein the polysaccharide polymer has an average molecular weight in the range from about 50,000 to about 5,000,000.

94. The medical device of claim 88 wherein the polysaccharide is associated with a plurality of quaternary ammonium cations.